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Learning and Motivational Processes When Students Design Curriculum-Based Digital Learning Games

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Abstract: This design-based research (DBR) project has developed an overall gamified learning design (big Game) to facilitate the learning process for adult students by inviting them to be their own learning designers through designing digital learning games (small games) in cross-disciplinary subject matters. The DBR project has investigated and experimented with which elements, methods, and processes are important when aiming at creating a cognitive complex (Anderson and Krathwohl, 2001) and motivating learning process within a reusable game-based learning design. This project took place in a co-design process with teachers and students. The learning approach was founded in problem-based learning (PBL) and constructionist pedagogical methodology, building on the thesis that there is a strong connection between designing and learning. The belief is that activities that involve making, building, or programming provide a rich context for learning, since the construction of artefacts, in this case learning games, enables reflection and new ways of thinking. The students learned from reflection and interaction with the tools alone as well as in collaboration with peers. After analysing the students' learning trajectories within this method of learning, this study describes seven areas of the iterative learning and game design process. The analysis also shows that the current learning design is constructed as a hierarchy supported through different roles as learning designers contained within one another. The study found that the students benefitted from this way of learning as a valid variation to more conventional teaching approaches, and teachers found that the students learned at least the same amount or more compared to traditional teaching processes. The students were able to think outside the box and experienced *hard fun* (Papert, 2002) - the phenomena that everyone likes challenging things to do, as long as they are the right things matched to the individual. They were motivated by hands-on work and succeeded in developing four very different and meaningful learning games and game concepts, which contributed to achieving their learning goals.

Keywords: Students as learning game designers, learning game design, game design models, constructionism, PBL, students as learning designers.

1. Introduction – a need for motivating learning processes

Motivation to learn decreases from the beginning of school age and becomes lowest upon entering the work force. In American elementary schools, 76% of students feel engaged, in middle school this figure falls to 61%, in high school 44%, and in workplaces worldwide as low as 13% of employees feel engaged in their jobs (Gallup, 2012; Gallup, 2013). Some researchers consider this a sign of a motivational crisis in the educational system (Sørensen et al., 2013). Since motivation to learn has an effect on students' ability to complete an education as well as on the quality of their results in school, this calls for new knowledge about increasing students' motivation to learn. The following is an example of how a student has trouble maintaining motivation:

> People "die" really quickly . . . there are some teachers who are really good at involving us and there are others who are not – we also have that experience here in the class, where there are some lessons where we are just falling totally out, because the teachers are just too good to stand and talk a little by themselves. Then they just from time to time ask: Well what do you say? [Student changing tone of voice:] I don't really know, because you have talked for 2 hours, and I have not kept up [with what you are saying] half of the time because it was boring. (Interview with a student in the research project class concerning a lesson with little student activity.)

You can bring a horse to water, but you cannot force it to drink. Similarly, you can seek to create a learning process for students, but you cannot force them to learn. So since the ability to facilitate the learning process is at the core of every teacher's duty, motivation becomes central as well. Motivation is thus part of every teacher's responsibility when creating activities and facilitating learning, but the will to learn is also something that students can be educated to choose and take responsibility for (Illeris, 2007; Bruner, 1966). The interest, will, and desire to learn are important parts of the learning process – a student's attention must be placed on *what is to be learned*, otherwise what they learn will be shallow at best. Motivation can also influence when individuals choose to learn, as well as what and how they learn. When people are motivated, they are more likely to undertake challenging activities and be actively engaged. Students who are motivated enjoy adopting a deep approach to learning and also tend to exhibit enhanced

performance, persistence, and creativity (Schunk, 2012). Consequently, motivation becomes an important part of the learning design and we have to develop conscious strategies for creating motivating learning situations.

Is it for instance possible to learn by using elements from games in our teaching approaches, using these elements to aid motivation in our education system? Fifty-nine percent of Americans play videogames, the average player is 31 years old, and half of the players are women (ESA, 2014). Seventy percent of teachers who use video games in their classes claim that the games increase students' motivation and engagement levels. This wide use of games – also among adults – invites continual investigation of how the use of games or game elements may open possibilities for merging motivational and engaging playful systems with traditional learning processes in formal education settings.

Many studies have supported the potential of using games in education as a means for learning (Gee, 2007; Barab, Gresalfi, and Ingram-Goble, 2010; Tobias and Fletcher, 2011). The use of games for learning is an active teaching approach, in which students are learning by doing, compared to a more traditional monologue form in which the teacher stands by a blackboard and talks about what is to be learned. Active teaching approaches can take on many shapes, and though evidence-based educational science is a difficult art (Biesta and Burbules, 2003), there is a variety of evidence supporting the idea that students will experience the learning process at a high level of cognitive complexity (Anderson and Krathwohl, 2001, pp. 67–68) through active learning (Michael, 2006). In this experiment, the goal was to turn the use of learning games into an even more active approach. If, instead of simply playing games, students are supported in building learning experiences into games – designing the games themselves – this may empower them as learners, teach them problem-solving skills, and enable a deeper understanding of the subject matter. The goal of this experiment was to enable a cognitive complex, motivating, and conscious learning process by letting students build learning games for fellow-students. The hypothesis was that this process would require the students to become very familiar with the curriculum that would be taught through the games. The questions investigated were: 1) What elements, practices, and processes are essential when creating sustainable, innovative, and motivating learning designs for teachers and adult students? 2) How does the learning design contribute to enabling a motivating and deep learning process?

2. Methodology and research project

This study is focused on the creation of an innovative and engaging gamified learning design in order to create motivating learning processes for adult students. The project was the result of three iterations of an on-going experiment. The investigation was conducted as a design-based research (DBR) study, in which the teachers and students were co-designers in the development and testing process. The study used mixed methods to investigate how the learning game design experiments answered the research questions. The collected data included field notes, video and audio recordings of actions and dialogs, observations from the workshops, semi-structured interviews with the teachers after each workshop, semi-structured interviews with the students after the last workshop, informal meetings, evaluation documents written by the students, questionnaires, videos of students' games being discussed and play tested, and the games themselves. The analysis took place by coding the transcribed data with an informed grounded theory approach (Thornberg, 2012), carried out as both a concept-driven and data driven coding process. Concept-driven coding uses concepts from theories and previous empirical data to find themes in reviewed data, whereas data-driven coding involves reading the data and searching for new phenomena that were not previously known (Kvale, 2009).

The experiment took place at VUC Storstrøm, an adult learning centre in Denmark. VUC Storstrøm offers the Global Classroom (GC) concept — a hybrid synchronous virtual and campus-based videoconference concept — to students attending an upper-secondary general education program, which is a full-time education program that lasts two years. The aim of this flexible class is to break down the walls of the classroom and offer a learning environment that responds to the needs of young adult learners (20–30 years old) to complete an education while fitting it into family and work life. Although teachers can ask their students to attend in person on specific days, the teachers generally prepare their daily teaching without knowing how many students will be in class versus how many will attend online. The students have different academic levels and different reasons for attending adult education classes, as well as different life situations and experiences. Furthermore, many students (60%) who attend VUC have at least one other discontinued education program in their pasts. This often influences their motivation to learn (Pless and Hansen, 2010; Sørensen et al., 2013). Therefore, the teachers in upper secondary classes at VUC strive to create a motivating learning environment for their diverse student groups. Recent reports have found that adult students enjoy activities with playful elements and that these elements help engage and motivate the students (EVA, 2014).

2.1 Research design

James Paul Gee (2011), a literacy and learning game theorist, defined the terms of little "g" game and big "G" Game. These terms are used to distinguish between what happens inside small digital games and "outside" these digital games — in the big Game where interactions between the players/learners take place as they discuss and negotiate the content, intention, and meanings of the small games - learning during this process. In spring 2015, two teachers and 19 students from Global Classroom participated in an experiment in which the overall learning design was made into a big Game while students designed learning goals for specific subject matters – history and English as a second language – into small digital games. The learning goals were focused on the American Civil War, human rights, and the liberation of the slaves. The sources the students used, as well as the game dialog, were expected to be in English. Teachers initially participated in a workshop, were introduced to the overall learning design, and tried some of the learning game design methods. Before the student workshops started, the teachers briefly introduced students to the subject matter, showed a film about the subject area, and introduced a few texts. The teachers and students then participated in three five-hour workshops once a week for three weeks that involved creating learning game concepts, making paper prototypes, and building digital learning games (Scratch and RGB-Maker) in a gamified learning environment. The teachers led the learning process while the researcher primarily observed.

3. Learning design and game design approaches – theoretical foundation

Because the design of learning games is a complex process, this project used different frameworks to support the students' development of learning games. The Smiley Model (Figure 1) was used as a heuristic for building learning games, and the overall learning design model (Figure 2) illustrates the intention behind the gamified learning design for students. The term *learning design* describes how the teacher shapes social processes and creates conditions for learning as well as the phenomenon of the individual student constantly re-creating or re-designing information through his or her own meaning-creation processes (Selander and Kress, 2012, p. 2; Laurillard, 2012).

3.1 The Smiley Model

The Smiley Model (Figure 1) is a learning game design model for building engaging learning games (Weitze and Ørngreen, 2012). The model was used to inspire and scaffold gamified learning processes in the current learning design. The Smiley Model addresses how to design the learning process and how to implement learning elements into the game while also considering ways to make the game motivating and engaging. The Smiley Model uses a learning design framework that considers the following elements: designing for the students' prerequisites for learning, the setting or learning situation, the learning goals, content selection, creation of relevant learning processes, and evaluation processes. The six game elements that can be used to *set the learning design into play* are: game goals, action space or narrative, rules, choices, challenges, and feedback. Each of the game elements are intertwined.

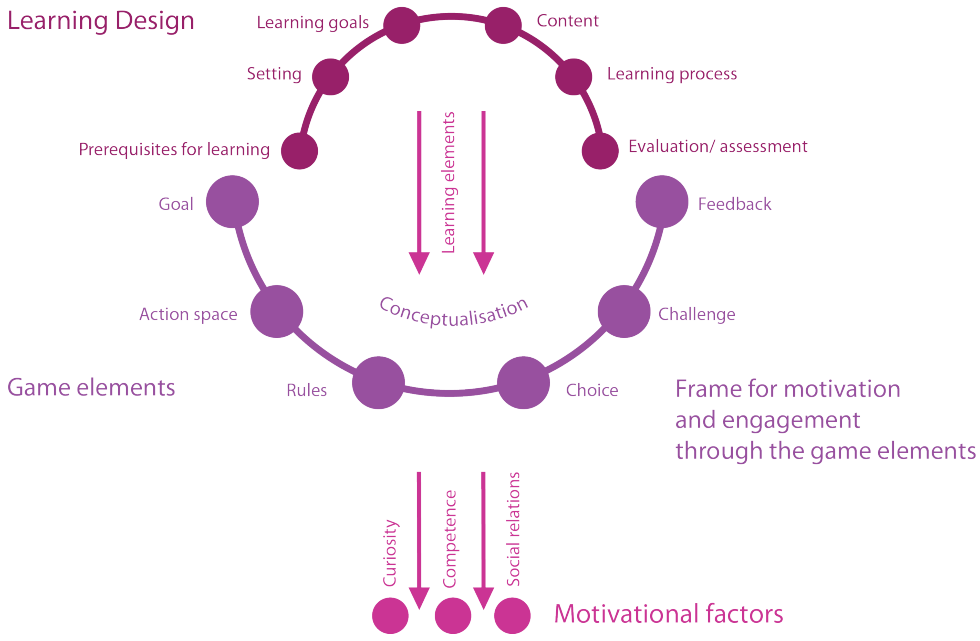

Figure 1: The Smiley Model (Weitze and Ørngreen, 2012)

The Smiley Model addresses the need to design the learning process, to set the learning elements into play through traditional game-elements, and to design for motivational factors. The three main underlying driving forces for our intrinsic motivation to learn are: 1) curiosity, 2) the feeling of achieving competence, and 3) reciprocity (Bruner 1966). These driving forces are further elaborated in Section 5.

3.2 The big Game and the small games

The goal for this experiment was to facilitate a motivating learning experience by making the whole *learning design* into a game. Inside this overall game, the students worked in teams and created digital learning games, while they embedded learning goals from the curriculum into each game (Figure 2) (Weitze, 2014a,b)

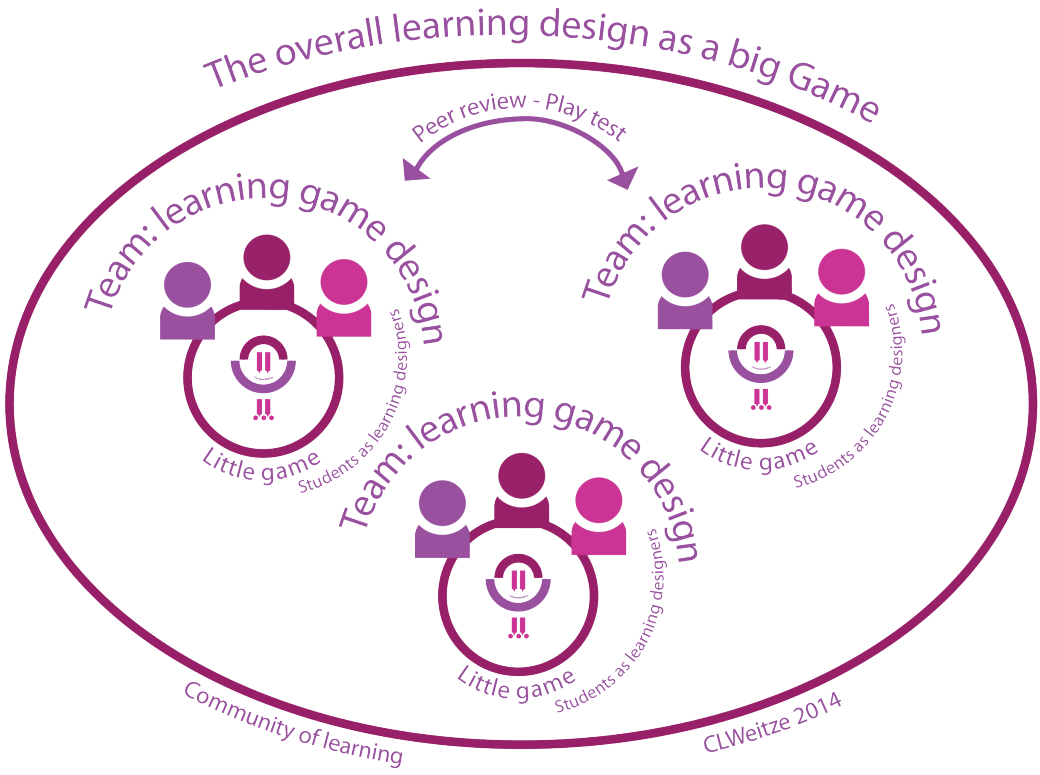

Figure 2: The gamified learning design.

The big Game for this project was designed in 25 levels, encompassing tasks for building learning games; the framework was presented in a Google document for each of the teams. The Smiley Model inspired the learning design of both the big and the small games. In addition to the motivational purpose of gamifying the learning game design process, another goal was structuring and scaffolding the learning process to help novice students and teachers create the small games (Weitze, 2014a,b). Therefore, the aim of this learning project was that the students would discuss, negotiate, and finally master the intended learning goals while building and implementing these learning goals into their little games. In other words*: the student-game-designers were learning inside the big Game while designing the small games*. Another ambitious sub-goal was that students from other teams would be able to learn by playing different the small games and discussing game concepts, thus gaining knowledge, skills, and competence during this process.

4. Theoretical and grounded analysis of the empirical data

To analyse whether the gamified learning design process can facilitate motivating learning processes for students, the project used the Danish learning theorist Knud Illeris' theoretical framework for learning processes. Illeris (2007) argued that every learning process involves the following three dimensions: 1) the inner psychological process of acquisition (the content dimension), 2) the interpersonal interaction dimension, and 3) willingness and desire to learn (the incentive-driven dimension) (Illeris, 2007). The first two dimensions are important in teaching and learning because they involve the cognitive (content) learning and collaborative learning domains, emphasizing that both

individual learning processes and social learning processes should be supported. However, the third motivational dimension is equally important in this case, since the target group in VUC's Global Classroom often possesses a weak motivation to learn. Therefore, the learning design has been focused on establishing individual, collaborative, and motivational learning processes for students.

The following sections will first analyse the students learning processes and trajectories in this project (4.1–4.4) and then analyse the motivating learning processes in the experiment (5–5.3). The purpose is twofold: to identify the facilitated learning and motivating processes taking place, and to find patterns that can be supported in future gamified teaching situations to enable motivational and deep learning processes for students.

4.1 Learning in the big Game

In the overall learning design – the big Game – the learning processes were facilitated by a problem-based learning approach (PBL). The students engaged in a learning process involving the development of a digital learning game. These small games then facilitated learning processes for their fellow students, by presenting and inviting interaction with game content that was relevant within the given learning goals. In order to find a solution to this problem and develop the project, teachers facilitated the learning process; the students were self-directed learners, and they dealt with problems as the driving force for inquiry corresponding to the principles of PBL (Savery, 2015). To assess what the students learned in this experiment, the project analysed what students and teachers said and did during pre- and post-experiment interviews and on-task activities. Furthermore, the main way the teachers evaluated students was through formative evaluative conversations and on-going discussions, as well as by asking each student to answer questions in Google docs about how well they understood the day's learning goals. This class is given an examination covering all subjects at the end of the year, and they do not have any formal marks before that day. Therefore, the students were generally very open concerning their understanding of the subjects, since the only purpose of the teachers' questions was to find out how they could support each student in the learning process. According to the teachers' analysis and evaluations of dialogues with the students, the conclusion was that the students learned the same amount or more, as compared with traditional lessons. Several students stated that the project required them to dive deep into the subject area, when building learning games, this resulted in memorable learning experiences.

4.2 Students as learning designers

One way to involve students in the learning process is to design learning processes in a way that enables the students to be self-directed learners. The process of students directing their own learning processes allows them to become their own learning designers.

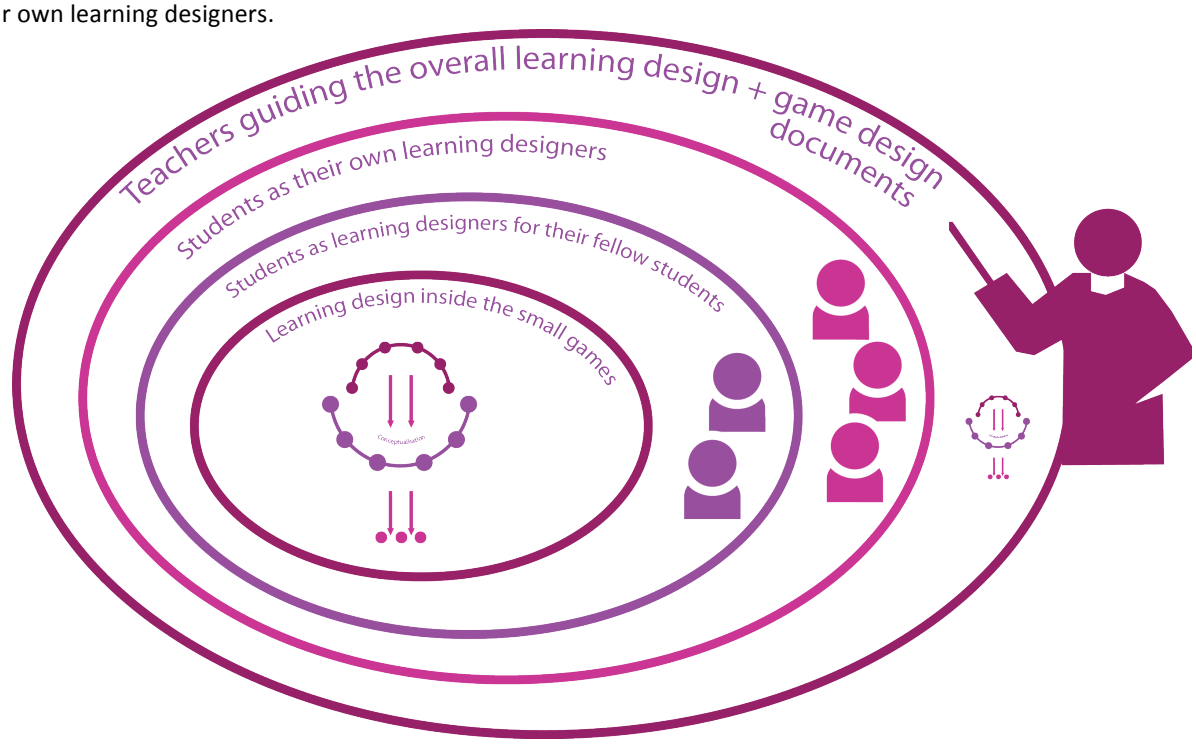

Figure 3: Learning designers in the game development process.

In order to activate the students as their own learning designers and also allow them to reach their learning goals, the process must be facilitated and guided by a teacher. In this experiment, the teachers were learning designers for the students, assisted by the game design assignments in the big Game. Additionally, the students were their own learning designers, both individually and in collaboration, as they discussed the subject matter, found content, and negotiated how to implement learning into the small digital games.

The students planned ways to develop and implement relevant content into their own small learning games. By experiencing innovative learning processes, students developed knowledge about and an understanding of facilitating learning processes inside their prototype games. Students were empowered to choose the specific learning goals that players of their games should master as well as how these goals should be facilitated in their games. The students thus planned ways to facilitate both the learning process and the evaluative process inside their small games within specific subject matters. They also continuously discussed and evaluated their projects, aided by feedback from the teachers and playtests performed by their fellow students. Therefore, the students not only acted as their own learning designers and led their own learning process, but they also acted as learning designers for their fellow students – as they worked to facilitate learning activities and learning trajectories inside the small games. This process can be illustrated as different levels of responsibility for acting as learning designers and creating learning designs in a game development process (Figure 3).

4.3 The students learning trajectories when building the small games

This research project used grounded theoretical methods to investigate and differentiate between the learning processes that took place while students designed learning games. The analysis showed that while the students built the learning games, they went through an iterative process consisting of seven areas, in the learning-game design process, including conceptualising and building the games (Figure 4). These areas were not visited in a specific order, but rather arose when relevant. The students were self-directed learners as they chose how to solve the problem of developing a game, but they were scaffolded by the Smiley Model when solving tasks in the big Game. Therefore, the following learning trajectories also encompass elements from the Smiley Model.

Conceptualizing and building small learning games. The focus on the learning game prototypes and discussions about building these games was an important overall goal. The prototypes became materials for learning and enhanced the students' ability to conceptualize and create their learning ideas in the following ways:

a) For individual students: The materials *talked back* (Schön, 1992), allowing students to become aware of gaps in their learning ideas or adaptions that may be required for specific learning situations and materials (Löwgren and Stolterman, 2007).

b) For teams: The materials could be used in learning design and game design discussions between students, and between students and teachers. This is equivalent to a constructionism approach to learning through design, in which the construction of artefacts enables reflection and new ways of thinking, based on the tools students use alone as well as in collaboration with peers (Kafai and Resnick, 1996).

Figure 4: Learning trajectories when building small digital learning games

The students learning trajectories when conceptualizing and building small learning games were:

1) Studying and re-studying the learning goals and deciding their specific take on them. This process made the students conscious of what they were expected to learn. This topic was also continuously discussed with the teachers.

2) Researching reliable sources in textbooks and on the Internet. For example, texts, videos, and sources from the Library of Congress were used as reliable sources. One of the learning goals involved being able to determine whether the historical sources were valid; therefore, this was an important focus for the students as well. In this learning situation – making learning games – assessing the validity of sources became meaningful for the students, since they sought to create good learning games for their fellow students, ensuring that the learning experiences were relevant and authentic.

3) Content for story environment. Because the subject of the games was focused on history, students looked for relevant content to develop a story environment. This is an important part of developing a game equivalent to the narrative and action scene in the Smiley Model.

4) Matching storyline and learning situations in the game design. The students searched for relevant historical material that would make a coherent story and create a learning environment for characters inside the little game – specific learning situations inside the little game that would create learning possibilities for the player. This was also supported by the teachers' formative evaluations, which encouraged the creation of small communities of practice in the games to enable learning situations.

5) Systems thinking. One of the advantages of using games and game design as learning tools is the possibility to show cause and effect as well as providing multiple learning paths from which to choose (Meadows and Wright, 2008). These conditions will engage the player of the game, as he or she experiences the freedom to choose and learn from his or her own path (Bruner, 1966). As an example, one of the teams developed a game concept in which the player/learner could choose to be either Abraham Lincoln or Jefferson Davis in the American Civil War. The team conducted thorough research on how the different actions in the war resulted in different consequences. They debated heavily on how they could allow the player choose to see these consequences from the perspective of either the Northern or Southern states. After these conducting research and debates, the students mastered this aspect of the topic and were able to discuss it in great detail with their fellow students. Findings from the first iteration of this experiment (spring 2014) showed that it would enable higher levels of cognitive complexity in the learning process for students to develop learning games that were more complex than simple quiz games (Weitze, 2014a,b). This is due to the fact that quiz games often only require memorizing specific facts and therefore only achieve the remembering level of cognitive complexity (Anderson and Krathwohl, 2001, pp. 67–68). The teachers also facilitated thinking in terms of cause and effect during the game design.

6) Designing specific game mechanics and facilitating learning and evaluation processes. The teachers encouraged students to facilitate both learning and evaluation processes in and around the small games. They also discussed how game mechanics – what the players/students could *DO* in the little game – were connected to specific learning goals that should be facilitated in the game. This resulted in many interesting and important findings that will be further described in a future article. As a single example, one of the teams created a story line inside the game and later invited the player to choose between different alternative solutions connected to the story. These alternatives or choices had different consequences, similar to the real life consequences that would have occurred at the time of the American Civil War. In this way, the players were educated by listening to the storyline and by the consequences of their own choices while playing the game. These game mechanics were also guided by the game elements in the Smiley Model: facilitation of goals, choices, challenges, rules, and feedback.

In summary, while teams worked through each of the previously mentioned learning trajectories, they reflected on and developed academic knowledge; more than one student stated that they would be able to remember details about the historical period they worked on for the rest of their lives. The concept of learning by doing – working through different learning trajectories while building games and being one's own learning designer – was successful for the students' learning processes both individually and collaboratively. The process offered a good alternative to *being told* about this historical period using a monologue-based pedagogical approach.

5. Motivation in the learning design

As stated in the introduction, motivation is an important part of learning. Jerome Bruner (1966), a noted educational psychologist, has a learning theorist approach to motivation. He believes that our intrinsic motivation to learn consists of three main underlying forces: 1) curiosity: the desire and freedom to explore things and the agency to decide for oneself – being in a playful and investigative mood; 2) achieving competence: the desire to show that we can do things and therefore are independent individuals; mastering a subject creates joy and pride and is motivating; and 3) reciprocity and relatedness: the desire to be an indispensable part of the community. People like to achieve goals with

others, learning as part of a community of practice (Wenger, 1998). It is argued that if learning is planned in a way that enables students to achieve one or more of the three motives described above, students will be more likely to feel an inner motivation to learn (Bruner, 1966). Deci and Ryans' self-determination theory (2000) argued that in order to achieve inner motivation, you should be reinforced in autonomy, competence, and relatedness, and that these concepts are vital to cover essential psychological needs (Deci and Ryan, 2000). The three main keys to motivation described by Deci and Ryan strongly resemble Bruner's three driving forces.

In this VUC class, the teachers experienced problems creating social learning processes for their students. According to feedback from teachers, the students still had very few interactions with each other after five months – in class as well as during breaks. The students were quiet and reserved, and often only contributed minimally during the facilitated teamwork in class. Therefore, one of the goals of this study was to enable motivating social and collaborative learning processes. In the first workshop, the teachers agreed that they had not previously seen a similar level of active participation from their students. After the last workshop, one teacher stated, "…it has obviously been working miracles for the social environment in class. Almost everyone worked hard and … I think that many of the quiet students really brightened up in this period. We have previously faced a real struggle creating a good social atmosphere" [translation by author]. The teachers also reported that the new positive social learning habits still remained two months after the experiment. This raises a question regarding what part of the learning design caused these improvements in the social learning processes, which can be difficult to assess in the "messy setting" of a learning situation. However, when seeking to understand how a motivating learning situation arose, it is relevant to examine both the characteristics of the learners and the learning design. Seventy percent of the students in this class played games on a daily basis, which may have contributed to their positive attitude towards creating games in class. According to interviews and observations, the students were more motivated and engaged than normal. The teachers observed that almost everyone participated actively – generally only three or four students showed this level of participation. The teachers were also surprised that students worked for five hours in a row, choosing to neglect their breaks. This was considered a further sign of engagement in the learning process. Bruner's three motivational forces (1966) were used as lenses when analysing motivational processes in this project, as detailed below.

5.1 Facilitating curiosity

Curiosity is fundamental to learning – it is innate. Curiosity makes us investigate our surroundings in a playful way, looking for the borders of our knowledge and experiences. Curiosity also makes us challenge ourselves to go out into the unknown, where we are *novices* (Bruner, 1966; Illeris, 2007). Curiosity is part of the inner motivation to learn (Deci and Ryan, 2000). The adult students worked hard to create their learning games and were generally very engaged in the process. Even when they struggled with the concept of developing a learning game – a new endeavour for them – they carried on, often due to good advice and guidance from their encouraging teachers (Weitze, 2016). Papert (2002) coined an expression called *hard fun* that describes the phenomena that everyone enjoys having challenging things to do, as long as the challenges are properly matched to each individual, their developmental states, and the current culture. One goal of this iteration of the learning design project was establishing a feeling of *hard fun* in the digital game design phase, as well as in the conceptual development phase (Weitze, 2014a). The students experienced a level of hard fun when designing; they struggled with their assignments to design learning games, and they succeeded in creating four very different and meaningful games.

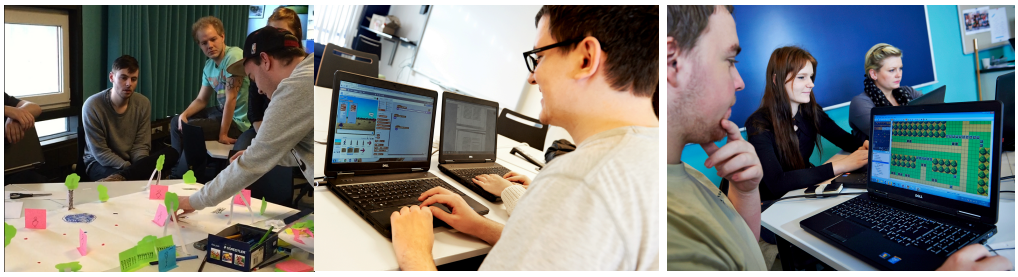

Figure 5: Prototypes – materials for learning

5.2 Creating the feeling of competence

Apart from small periods of uncertainty regarding their next steps, the students worked very diligently to create good learning games. They were enthusiastic when they explained the games that they were creating, and they thoroughly described the details and how they were trying to think outside the box to avoid simple quiz games (Weitze, 2014b).

During the second and third workshops, the students expressed a feeling of pride for their games and a will to master the challenge of creating a learning game. The overall learning design process enabled them to gain many additional competences: gathering knowledge to meet learning goals, creating a storyline and English dialogues for characters in the games, building paper prototypes while discussing learning goals, and coding the digital games while implementing learning objects. According to the teachers, this new variety of tasks and the opportunity for hands-on work while developing the small learning games appealed to a group of students who had previously been quiet and inactive. The students developed detailed prototypes (Figure 5) that they used to discuss how learning should be implemented in the game. It was clear that the students enjoyed making these prototypes, and the teachers witnessed the emergence of new competencies among many of the students and also noted that they were generally more enthusiastic and willing to participate.

5.3 Making reciprocity and relatedness possible

One of the teachers' main goals for this experiment was to create a more engaging social environment for their adult students. This goal was achieved to a great extent, and the effect lasted after the workshops ended. The big Game was designed, so students were able to collaborate and compete in a friendly way on teams. There were many observations of engaging collaborative processes. These processes allowed the students to learn from each other and to create knowledge together: they read aloud for each other from the sources and discussed and negotiated what content to implement in the games and how to create historically realistic learning game experiences for their fellow students. The students explicitly expressed that they enjoyed working on their teams because their specific group had good teamwork. This teamwork could be readily observed as the ability to work together, solve problems, and discuss relevant matters. It was also evident in their ability to divide the workload in ways that acknowledged each group members' strengths – for example, being good at coding versus being good at writing dialogues. As mentioned earlier, the teachers expressed that it had previously been difficult to create a good sense of collaboration in the class. The big Game had explicit rules for gaining Social Experience points (SXP). To gain SXP, you could help other teams, ask the other teams for help, or make sure that everyone in the team participated equally on each level. This rule regarding SXP was stated from the start, and the students joked about it throughout the workshops. The existence of the SXP points system may have contributed to the students' enhanced attention towards creating a good working environment.

By using Bruner's (1966) three motivational forces as analytical tools, this study suggests that the students and teachers experienced many different motivational learning processes in this learning design; the analysis also indicates that the motivational learning processes were supported by the overall learning design – the big Game – and by building the small games. This is an important finding because creating a motivating learning process capable of supporting a cognitive complex learning process for the students was the primary aim of the study.

6. Conclusion

This study experimented with creating a reusable, innovative, and motivational learning design for adult student-game-designers, allowing them to *learn inside a big Game while designing small digital learning games* in cross-disciplinary subject matters. The findings have shown that this learning design contributed to a motivating and deep learning process for the students. This was facilitated by both individual and collaborative learning processes. Using learning game design – an activity with playful elements – as a learning method was engaging for this adult audience, who found the task both challenging and motivational. The learning approach was a combination of problem-based learning and constructionism and the students were implementing history and English as a second language into the games. The overall learning design used the Smiley Model as a framework for the big Game, to guide the learning and game design processes for the students and teachers. The findings showed that the central theme of the learning process was conceptualizing and building small learning games by building upon the following six areas in the iterative learning-game design process: 1) studying learning goals; 2) researching authentic and relevant sources; 3) choosing relevant content for the story environment; 4) matching content with a storyline and learning environment in game design; 5) systems thinking – looking for cause and effect relationships and providing multiple paths; and 6) designing game mechanics – learning and evaluation. During the analysis, it was determined that the following learning design processes were contained within one another: the teachers guided the overall learning design assisted by the game design document; the students acted as their own learning designers leading their own learning process, but were also learning designers for their fellow students. Finally, learning processes were facilitated inside the small games.

Because motivation is an important part of learning, it was an important finding that many of the quiet students

became more actively involved – according to the teachers, this experimental learning process greatly improved the social environment in class and everyone was actively involved. When using Bruner's (1966) three motivational forces as analytic tools (curiosity, the feeling of achieving competence, and reciprocity-relatedness) the findings were: 1) the students experienced inner motivation and *hard fun* and succeeded in making four very different and meaningful learning games; 2) the students tried to think "outside the box" and expressed a feeling of pride for their games and a will to master the challenge of making a learning game. The learning design enabled the students to develop many kinds of competences and work actively hands on, which seemed to appeal to a new group of traditionally quiet students; 3) there were many observations of engaging collaborative processes that allowed the students to learn from each other and to create knowledge together. The increase in these social learning processes may have been supported by specific social rules in the big game.

This DBR project used mixed methods and informed grounded theory to investigate and analyse the students' level of motivation and engagement in their learning processes. The analysis found signs of learning and motivation among the students and in co-design processes developed knowledge about how to refine this learning design.

Though DBR takes place in the complex setting of a classroom, this iterative experiment has created knowledge about a problem area and made important contributions to the researchers' and the teachers' learning processes. Future goals include continuing the development of this new way of learning, to further refine it and to disseminate it to interested teachers and students.

9. References

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